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The application of physical simulation and numerical simulation during deformation and service of non-ferrous metal

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ABSTRACT

The physical simulation and numerical simulation have been widely applied in many studies such as non-ferrous metal deformation and service because of its remarkable advantages. Thus, in this study, high-performance copper alloy in high pressure isolating switch and high-strength titanium alloy tube in aerospace are studied systematically and deeply by experimental investigations, and finite element (FE) analysis and analytical methods. A brief introduction of this study and its main achievements are as follows:

(1) Using physical simulation test method, the hot deformation behavior of high-performance copper alloy is studied based on the Gleeble-1500 thermal simulation testing machine, the effects of different deformation conditions on rheological stress of copper alloy are studied, and the constitutive equation and hot working diagrams are obtained. The flow law and stress state of metal are studied under different forming process by the DEFORM. Using the jigs and fixtures of design, service condition of high voltage isolation switch is studied. The stress relaxation law under different temperature and the stress relaxation characteristics under different stress state are researched.

(2) Key technology is resolved based on the ABAQUS, such as element, meshing, and friction condition. The FE model of numerical control (NC) bending and springback is established. Effect law of the wall thinning degree and the flattening degree of cross-section to NC bending deformation of high-strength titanium alloy tube under different geometry conditions and different process conditions are obtained. The reasonable parameter of tubes NC bending is obtained. Mechanism of variation characteristics for springback angle and springback radius is also studied. Moreover, the control model of bending angle and bending radius is obtained based on the prediction model of springback angle and springback radius. The qualified bent tubes of high-strength titanium alloy tube are obtained by experiment.